WE CLAIM:

1. A system for imaging a semiconductor wafer to detect defects therein, comprising:

an x-ray source for generating collimated x-rays;

a first aperture array, having a plurality of openings therethrough through which the collimated x-rays are substantially transmitted;

a second aperture array, having a plurality of openings therethrough through which x-rays may be substantially transmitted, the openings of the second aperture array being aligned with openings of the first aperture array, the first and second aperture arrays spaced apart from one another so that a semiconductor wafer may be inserted therebetween, the first aperture array being nearer the x-ray source than the second aperture array;

a detector array for detecting x-ray energy transmitted through the openings of the second aperture array; and

an analysis computer, coupled to the detector array, to receive signals therefrom corresponding to the detected x-ray energy.

2. The system of claim 1, wherein the first and second aperture arrays each comprise a film of high atomic number metal, through which the openings are disposed.

3. The system of claim 1, wherein the x-ray source comprises:

a rotating anode x-ray source.

4. The system of claim 1, wherein the x-ray source comprises a wavelength-tunable x-ray source.

5. The system of claim 1, further comprising:

a wafer translation system, for controllably translating the semiconductor wafer when disposed between the first and second aperture arrays.

6. The system of claim 5, wherein the wafer translation system is coupled to the analysis computer;

and wherein the analysis computer is for storing digital data corresponding to the detected x-ray energy in association with positional information communicated thereto by the wafer translation system.

7. The system of claim 1, wherein the detector array comprises:

a plurality of solid-state x-ray detectors, each associated with one of the plurality of openings of the second aperture array, each for generating a signal corresponding to the magnitude of x-ray energy transmitted through its associated opening of the second aperture array, and for communicating the signal to the analysis computer.

8. A method of detecting defects in a semiconductor wafer, comprising the steps of:

placing a semiconductor wafer between first and second aperture arrays, each of the first and second aperture arrays having a plurality of openings therethrough, through which x-ray energy may be transmitted, the openings of the second aperture array being aligned with openings in the first aperture array;

irradiating the first aperture array with x-ray radiation, so that x-ray radiation first passes through the plurality of openings through the first aperture array, then through the semiconductor wafer, and then through the plurality of openings through the second aperture array; and

detecting x-ray radiation transmitted through the second aperture array.

9. The method of claim 8, further comprising:

generating an image from the detected x-ray radiation.

10. The method of claim 9, wherein the detecting step comprises:

detecting x-ray radiation with a plurality of detectors, each associated with one of the plurality of openings through the second aperture array.

11. The method of claim 9, wherein the generating step comprises:

communicating a signal from each of the plurality of detectors to an analysis computer, the signal corresponding to the magnitude of x-ray radiation detected by the detector; and

operating the analysis computer to associate the communicated signals with a spatial location for the wafer.

12. The method of claim 11, wherein the irradiating and detecting steps are performed for a first location of the semiconductor wafer relative to the pluralities of openings through the first and second aperture arrays;

and further comprising:

after the detecting step, laterally translating the semiconductor wafer to a second location relative to the pluralities of openings through the first and second aperture arrays;

after the translating step, repeating the irradiating and detecting steps for the wafer at the second location.

13. The method of claim 8, wherein the irradiating and detecting steps are performed for a first location of the semiconductor wafer relative to the pluralities of openings through the first and second aperture arrays;

and further comprising:

after the detecting step, laterally translating the semiconductor wafer to a second location relative to the pluralities of openings through the first and second aperture arrays;

after the translating step, repeating the irradiating and detecting steps for the wafer at the second location.

14. The method of claim 13, further comprising:

after each of the detecting steps, communicating a signal from each of the plurality of detectors to an analysis computer, the signal corresponding to the magnitude of x-ray radiation detected by the detector;

operating the analysis computer to store digital data corresponding to the communicated signal from each of the plurality of detectors, the digital data stored in association with the location of the semiconductor wafer relative to the pluralities of openings through the first and second aperture arrays.

15. The method of claim 14, further comprising:

generating an image of the semiconductor wafer from the stored digital data.

16. The method of claim 14, wherein the first and second locations correspond to identical locations of first and second integrated circuit die on a surface of the semiconductor wafer;

and further comprising:

comparing the digital data stored in association with the first and second locations of the semiconductor wafer.

17. The method of claim 14, further comprising:

repeating the placing, irradiating, detecting, communicating, and operating steps for a plurality of semiconductor wafers; and

comparing the digital data stored in association with the locations of the plurality of semiconductor wafers.

18. The method of claim 11, further comprising:

operating the analysis computer to identify spatial locations of contrasting detected x-ray radiation, so that defects corresponding to the absence of conductor material may be distinguished from defects corresponding to the presence of undesired material.

19. The method of claim 11, further comprising:

operating the analysis computer to perform spatial processing of detected defects.

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